

CLAIMS

1. A vacuum pump comprising a molecular drag pumping mechanism and, downstream therefrom, a regenerative pumping mechanism, wherein a rotor element of the molecular drag pumping mechanism surrounds rotor elements of the regenerative pumping mechanism.

5 2. A pump according to Claim 1, wherein the rotor element of the molecular drag pumping mechanism comprises a cylinder mounted for rotary movement with the rotor elements of the regenerative 10 pumping mechanism.

15 3. A pump according to Claim 2, wherein the cylinder forms part of a multi-stage Holweck pumping mechanism.

4. A pump according to any preceding claim, wherein the rotor element of the molecular drag pumping mechanism and the rotor elements of the regenerative pumping mechanism are located on a common rotor of the pump.

20 5. A pump according to Claim 4, comprising an impeller mounted on a drive shaft of the pump, the rotor being integral with the impeller.

25 6. A pump according to Claim 5, wherein the rotor comprises a disc substantially orthogonal to the drive shaft.

7. A pump according to any of Claims 4 to 6, wherein the rotor elements of the regenerative pumping mechanism comprise a series of blades positioned in an annular array on one side of the rotor.

30 8. A pump according to Claim 7, wherein the blades are integral with the rotor.

9. A pump according to Claim 7 or Claim 8, wherein the rotor element of the molecular drag pumping mechanism is mounted on said one side of the rotor.

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10. A pump according to any of Claims 7 to 9, wherein the regenerative pumping mechanism comprises at least two series of blades positioned in concentric annular arrays on said one said of the rotor.

10 11. A pump according to any preceding claim, comprising a common stator for the regenerative pumping mechanism and at least part of the molecular drag pumping mechanism.

12. A pump according to any preceding claim, further comprising a
15 Gaede pumping mechanism, the rotor element of the molecular drag pumping mechanism surrounding the rotor elements of the Gaede pumping mechanism.

20 13. A pump according to any preceding claim, comprising an additional pumping mechanism upstream from the molecular drag stage

14. A pump according to Claim 13, wherein the additional pumping mechanism comprises at least one turbomolecular pumping stage.

25 15. A pump according to Claim 13 or Claim 14 when dependent from Claim 5, wherein a rotor element of the additional pumping mechanism is located on the impeller.

30 16. A pump according to Claim 15, wherein the rotor element of the additional pumping mechanism is integral with the impeller.

17. A pump according to any of Claims 13 to 16, comprising a pump inlet located upstream from the additional pumping mechanism and an outlet located downstream from the regenerative pumping mechanism.

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18. A pump according to Claim 17, comprising a second pump inlet located between the additional pumping mechanism and the regenerative pumping mechanism.

10 19. A pump according to Claim 18, wherein the second pump inlet is located between the additional pumping mechanism and the molecular drag pumping mechanism.

15 20. A pump according to Claim 18, wherein the second pump inlet is located between at least part of the molecular drag pumping mechanism and the regenerative pumping mechanism.

20 21. A pump according to Claim 18 or Claim 20, wherein the second pump inlet is located such that fluid entering the pump therethrough follows a different path through the molecular drag pumping mechanism than fluid entering the pump through the first-mentioned inlet.

25 22. A pump according to Claim 21, wherein the second pump inlet is located such that fluid entering the pump therethrough follows only part of the path through the molecular drag pumping mechanism of fluid entering the pump through the first-mentioned inlet.

30 23. A pump according to any of Claims 20 to 22, comprising a third pump inlet located between the additional pumping mechanism and the molecular drag pumping mechanism.

24. A pump according to any of Claims 13 to 23, further comprising a turbomolecular pumping mechanism upstream from the additional pumping mechanism.

5 25. A pump according to Claim 24 when dependent from Claim 5, wherein a rotor element of the turbomolecular pumping mechanism is located on the impeller.

10 26. A pump according to Claim 25, wherein the rotor element of the additional pumping mechanism is integral with the impeller.

27. A pump according to any of Claims 24 to 26, comprising a pump inlet located upstream from the turbomolecular pumping mechanism.

15 28. A pump according to any preceding claim, wherein, in use, the pressure of fluid exhaust from the pump is equal to or greater than 1 mbar.

20 29. An impeller for a vacuum pump, the impeller comprising a rotor element of a molecular drag pumping mechanism and a plurality of rotor elements of a regenerative pumping mechanism, wherein the rotor element of the molecular drag pumping mechanism surrounds the rotor elements of the regenerative pumping mechanism.

25 30. An impeller according to Claim 29, wherein the rotor element of the molecular drag pumping mechanism comprises a cylinder mounted for rotary movement with the rotor elements of the regenerative pumping mechanism.

30 31. An impeller according to Claim 30, wherein the cylinder forms part of a multi-stage Holweck pumping mechanism.

32. An impeller according to any of Claims 29 to 31, wherein the rotor element of the molecular drag pumping mechanism and the rotor elements of the regenerative pumping mechanism are located on a common rotor of the impeller.

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33. An impeller according to Claim 32, wherein the rotor is integral with the impeller.

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34. An impeller according to Claim 33, wherein the rotor comprises a disc substantially orthogonal to the longitudinal axis of the impeller.

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35. An impeller according to any of Claims 32 to 34, wherein the rotor elements of the regenerative pumping mechanism comprise a series of blades positioned in an annular array on one side of the rotor.

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36. An impeller according to Claim 35, wherein the blades are integral with the rotor.

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37. An impeller according to Claim 35 or Claim 36, wherein the rotor element of the molecular drag pumping mechanism is mounted on said one side of the rotor.

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38. An impeller according to any of Claims 35 to 37, wherein the regenerative pumping mechanism comprises at least two series of blades positioned in concentric annular arrays on said one side of the rotor.

39. An impeller according to any of Claims 27 to 38, comprising a rotor element for a turbomolecular stage.

40. An impeller according to Claim 39, wherein the rotor element of the turbomolecular stage is integral with the impeller.

41. A pump comprising an impeller according to any of Claims 27 to 40.

42. A vacuum pump comprising a molecular drag pumping mechanism and a regenerative pumping mechanism, a drive shaft having located thereon a rotor element for the molecular drag pumping mechanism and rotor elements for the regenerative pumping mechanism, and a common stator for both the regenerative pumping mechanism and at least part of the molecular drag pumping mechanism.

43. A pump according to Claim 42, wherein the rotor element of the molecular drag pumping mechanism surrounds the stator.

44. A pump according to Claim 42 or Claim 43, wherein the rotor element of the molecular drag pumping mechanism comprises a cylinder mounted for rotary movement with the rotor elements of the regenerative pumping mechanism.

45. A pump according to Claim 44, wherein the cylinder forms part of a multi-stage Holweck pumping mechanism.

46. A pump according to any of Claims 42 to 45, wherein the rotor element of the molecular drag pumping mechanism and the rotor elements of the regenerative pumping mechanism are located on a common rotor of the pump.

47. A pump according to Claim 46, comprising an impeller mounted on the drive shaft, and wherein the rotor is integral with the impeller.

48. A pump according to Claim 47, wherein the rotor comprises a disc substantially orthogonal to the drive shaft.

49. A pump according to any of Claims 46 to 48, wherein the rotor elements of the regenerative pumping mechanism comprise a series of blades positioned in an annular array on one side of the rotor.

5 50. A pump according to Claim 49, wherein the blades are integral with the rotor.

51. A pump according to Claim 49 or Claim 50, wherein the rotor element of the molecular drag pumping mechanism is mounted on said one 10 side of the rotor.

15 52. A pump according to any of Claims 49 to 51, wherein the regenerative pumping mechanism comprises at least two series of blades positioned in concentric annular arrays on said one said of the rotor, and the stator comprises a corresponding number of channels within which the blades can rotate.

20 53. A pump according to any of Claims 42 to 52, further comprising a Gaede pumping mechanism having a plurality of rotor elements positioned in an annular array, the stator comprising a channel within which the rotor elements of the Gaede pumping mechanism can rotate.

25 54. A pump according to Claim 53, wherein the rotor element of the molecular drag pumping mechanism surrounds the rotor elements of the Gaede pumping mechanism.

30 55. An impeller for a vacuum pump, the impeller having integral therewith a rotor element of a turbomolecular pumping stage, a plurality of rotor elements of a regenerative pumping mechanism, and a rotor for receiving a rotor element of a molecular drag pumping mechanism.

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56. An impeller according to Claim 55, wherein the rotor comprises a disc substantially orthogonal to the longitudinal axis of the impeller.

57. An impeller according to Claim 55 or Claim 56, wherein the rotor elements of the regenerative pumping mechanism comprise a series of blades positioned in an annular array on one side of the rotor.

58. An impeller according to Claim 57, wherein the rotor elements of the regenerative pumping mechanism comprise at least two series of blades positioned in concentric annular arrays on said one said of the rotor.

59. An impeller according to Claim 57 or Claim 58, wherein the rotor is arranged to receive a rotor element of the molecular drag pumping mechanism on said one side of the rotor.